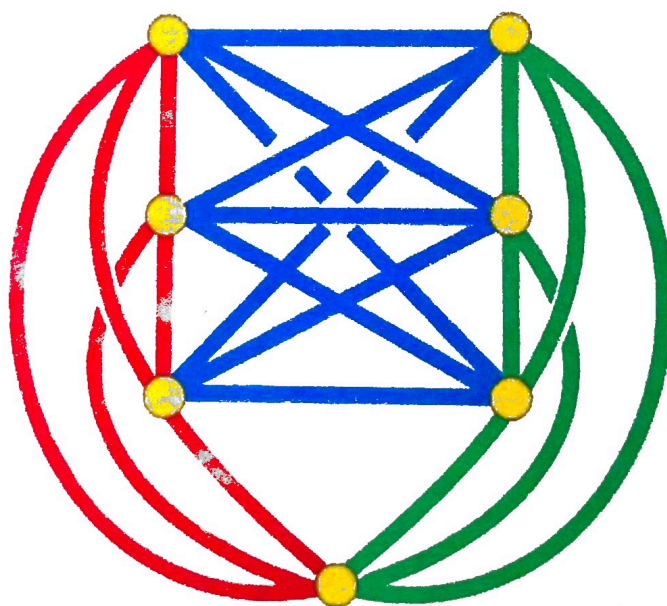


Двадцятий Міжнародний науково-практичний семінар

Комбінаторні конфігурації та їх застосування

13-14 квітня 2018 року



Кропивницький
2018

Kartashov O., Korobchynskiy K., Skrypka B.

N.E. Zhukovsky National Aerospace University

"Kharkiv Aviation Institute"

SOME PROBLEMS OF OPTIMIZATION IN THE
CONFIGURATION SPACE OF SPHERICAL OBJECTS... 11

Shmelova T., Sikirda Yu.

National Aviation University,

Flight Academy of the National Aviation University

RESEARCH METHODOLOGY IN AIR NAVIGATION
SOCIO-TECHNICAL SYSTEM..... 13

Yakovlev S.V.

N.E. Zhukovsky National Aerospace University

"Kharkiv Aviation Institute"

SOME APPLICATIONS OF THE THEORY OF
CONFIGURATION SPACES OF GEOMETRIC OBJECTS 18

Бондарь О.П.

Летная академия НАУ

КОМБИНАТОРНЫЕ КОНФИГУРАЦИИ В
АВИАЦИИ..... 20

Воблый В. А., Архипова Н.А.

ВИНИТИ РАН

ЗАДАЧА ПЕРЕВОДА СОБСТВЕННЫХ ИМЕН В
ИНФОРМАЦИОННОЙ СИСТЕМЕ «МАТЕМАТИКА».. 22

Воблый В. А.

ВИНИТИ РАН

ОБ ОДНОМ ТОЖДЕСТВЕ ДЛЯ МНОГОЧЛЕНОВ
КРАВЧУКА..... 25

Воблый В. А., Мелешко А. К.

ВИНИТИ РАН, МГТУ им. Н.Э.Баумана

ПЕРЕЧИСЛЕНИЕ ПОМЕЧЕННЫХ БЛОЧНО-
КОЛЕСНЫХ ГРАФОВ..... 28

Волков Ю.І.

*Центральноукраїнський державний педагогічний
університет імені Володимира Винниченка*

ПРО ОДНУ ВЛАСТИВІСТЬ Q-БІНОМІАЛЬНИХ

SOME PROBLEMS OF OPTIMIZATION IN THE CONFIGURATION SPACE OF SPHERICAL OBJECTS

Kartashov O., Korobchynskyi K., Skrypka B.

alexeykartashov@gmail.com; kirill.korobchinskiy@gmail.com;
skripkabodya@gmail.com

*N.E. Zhukovsky National Aerospace University
"Kharkiv Aviation Institute"*

Аннотация. Рассмотрено конфигурационное пространство сферических объектов, обобщенными переменными которых являются радиус и координаты центров шаров. Исследована проблема оптимизации размещения шаров при различных критериях качества и ограничениях на их взаимное расположение.

Abstract. The configuration space of spherical objects is considered, the generalized variables of which are the radius and coordinates of the centers of the balls. The problem of ball placement optimization under different quality criteria and constraints on their mutual placement is investigated.

Consider the problem of synthesizing the optimal configuration of objects of a spherical shape. Let a system of geometric objects S_i , $i \in J_n$ having the shape of a sphere be given. We associate with each of the balls S_i our own coordinate system by selecting its origin (called the pole) at the center of symmetry of the sphere. Then the geometric information $g^i = (\{s^i\}, \{\mu^i\}, \{p^i\})$ about the object S_i will include the form $\{s^i\}$, metric parameter $\{\mu^i\} = r_i$ and placement parameters $\{p^i\} = (x_i, y_i, z_i)$. We use Stoyan-Yakovlev theory of configuration space and form the configuration space of spherical objects as the manifold of the space of geometric information [1-3].

The spatial form of a ball in a fixed coordinate system $Oxyz$ is given by parametrically given family of functions $f(\xi, r) \in C(R^3) \times R_+^1$, $\xi = (x, y, z)$, described by the boundary equation

$$f(\xi, r) = r^2 - x^2 - y^2 - z^2 = 0. \quad (1)$$

The equation of the general position of the sphere S_i of radius r_i with the placement parameters $p^i = (x_i, y_i, z_i)$ in the fixed coordinate system $Oxyz$ takes the form

$$F(\xi, x_i, y_i, z_i, r_i) = r_i^2 - (x - x_i)^2 - (y - y_i)^2 - (z - z_i)^2 = 0.$$

Geometric information $g^i = (\{s^i\}, \{\mu^i\}, \{p^i\})$ induces configuration spaces $\Xi^4(S_i)$, $i \in J_n$ with generalized coordinates r_i, x_i, y_i, z_i .

Consider the configuration space of the set of balls S_i , $i \in J_n$, which we represent as

$$\Xi^{4n}(S_1, \dots, S_n) = \Xi^4(S_1) \times \dots \times \Xi^4(S_n).$$

The point $g = (r_1, x_1, y_1, z_1, \dots, r_n, x_n, y_n, z_n) \in \Xi^{4n}(S_1, \dots, S_n)$ determines the configuration of the balls S_i , $i \in J_n$ and uniquely determines their location in the fixed coordinate system $Oxyz$.

On the set of balls S_i , $i \in J_n$ we introduce the binary relation $\{*\}$, assuming $S_i * S_j$, if $\text{int } S_i \cap \text{int } S_j = \emptyset$. In the configuration space $\Xi^{4n}(S_1, \dots, S_n)$, the relation $S_i * S_j$ is formalized by means of inequality

$$r_i + r_j - \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2 + (z_i - z_j)^2} \geq 0 \quad (2)$$

Define a matrix $B = [b_{ij}]_{n \times n}$ with elements

$$b_{ij} = \begin{cases} 1, & \text{if } S_i * S_j; \\ 0, & \text{otherwise.} \end{cases}$$

The configuration of balls S_i , $i \in J_n$ is said to be admissible if condition (2) for any $i, j \in J_n$ such that $b_{ij} = 1$.

Suppose that a certain function to be optimized is given on the

set of admissible configurations of balls $S_i, i \in J_n$. We obtain the optimization problem of determining generalized variables $r_1, x_1, y_1, z_1, \dots, r_n, x_n, y_n, z_n$ of a configuration space $\Xi^{4n}(S_1, \dots, S_n)$, which has a lot of geometric interpretations and practical applications.

The report proposes a classification of such problems depending on the type of function being optimized and the choice of generalized variables.

Literature

1. Stoyan Y.G., Yakovlev S.V. Mathematical models and optimization methods of geometrical design. Kiev: Nauk. Dumka. - 1986. - 256 pp.
2. Stoyan Y.G., Yakovlev S.V. The configuration space of geometric objects. // Cybernetics and Systems Analysis. - 2017. V. 53(5), P. 725–732.
3. Stoyan Y.G., Yakovlev S.V. The configuration space of geometric objects. // Cybernetics and Systems Analysis. - 2018. V. 54(5), P. 715–724.

RESEARCH METHODOLOGY IN AIR NAVIGATION SOCIO-TECHNICAL SYSTEM

Shmelova T.,

Shmelova@ukr.net

National Aviation University

Sikirda Yu.

SikirdaYuliya@ukr.net

Flight Academy of the National Aviation University

Аннотация. Представлена методология проведения научных исследований для анализа развития полетной ситуации под влиянием принятия решений человеком-оператором аэронавигационной социально-технической системы.

Abstract. The research methodology for analysis of flight situation development under influence of decision making by the human-operator of Air Navigation Socio-technical System has been presented.